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Effect of organic and bio-fertilizers on okra plant growth

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This experiment aimed to determine the impact of organic and biological fertilizers on the development of the okra plant. The research was carried out in a private field in the Al- Madinah district north of Basra during the 2022 agricultural season. Organic manure (cow manure) was added to the soil at two different rates of 5% and 10% of the soil weight at a depth of 30 cm. Biofertilizer was sprayed on the leaves at three different rates of 2%, 4%, and 8 g/l of yeast suspension. Comparisons were made between the outcomes and the control group (without any addition). The experiment outcomes demonstrate that all indicators of vegetative growth and production were maximized by treating organic fertilizer at 10% concentration and spraying biofertilizer at 8 g/liter concentration. It attained the most significant values for plant height, leaf number, leaf area, fruit weight, and overall plant yield, measuring 156.18 cm, 85.34 leaves, 1.48 m2, 4.86 g, and 338.16 g/plant, respectively.
Keywords: Fertilizers; biofertilizer; spraying biofertilizer; organic fertilizers; plant yield.

INTRODUCTION

Okra (Abelmoschus esculentus L.) belongs to the Malvaceae family. It is among the most important summer vegetable crops cultivated in Asia and Africa's hot and warm climates. It is called by several names, including okra, lady finger, gumbo, and Bamhia (Bonhert, 2008).

Okra is widespread in Iraq, where it is grown in all regions of the country to obtain pods that are eaten after cooking or used in a frozen or dried form during the winter season. Its nutritional importance comes from the fact that it contains carbohydrates, protein, fiber, fats, mineral salts, such as calcium and iron, and vitamins, such as A, B1, B2, and C (Al-Rikabi and Jassim, 1981).

One aspect of sustainable agriculture is organic agriculture. Instead of relying on the flow of outside agricultural inputs, it is a holistic system of production that depends on maintaining and regulating the natural ecosystem (processed materials). It considers the possible social, health, and environmental effects by ceasing to use of all commercial fertilizers, pesticides, and growth regulators in favor of what is natural and readily accessible in the agricultural environment. This is done by recycling natural resources, such as plant residues and animal waste (Patil *et al.*, 2004).

Besides significantly enhancing soil's chemical and physical characteristics, animal fertilizers are the primary and safe source of nutrients for plants and humans. Sheep and poultry manure, rich in nutrients, are two of the most popular animal fertilizers. Poultry manure has a high nitrogen and phosphorus concentration, whereas cattle manure has a high concentration of potassium (Herawati, 1994).

Compost activates soil microbial biomass and maintains the ecosystem through waste cycling (Tonfack *et al.*, 2009). On the other hand, biofertilizers are among the topics that have gained the attention of many researchers in recent years (El-Ghamriny *et al.*, 1999). Baking yeast (Saccharomyces cerevisiae) is a fungus that contains vitamins, amino acids, and proteins and is a natural source of cytokinins. In addition to containing some essential elements for plant growth (Ei-Tohamy *et al.*, 2008). Many researchers have used baking yeast in biofertilizer plants.

Al-Degwi (1996) mentioned that yeast contains reduction substances such as glycogen ($C6H10O5$), fats, and vitamins such as 9.7 mg/100g yeast of B1 (Thiamin), 5.45 mg/100g yeast of B2 (Riboflavin), 0.45. 2.47 mg/100g yeast B3 (Pantothenic acid), and 2.47 mg/100g yeast of B6 (Pyridoxine).

Yeast has a high protein, vitamin, and hormone content, making it a natural biofertilizer. It impacts the environment less than chemical fertilizers (Ahmed, 2004). It is a natural source of cytokinin, which promotes cell elongation, division, and the production of chlorophyll, nucleic acids, and protein in plants (Fathy and Farid, 1996).

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Table 1. Soil chemical and physical characteristics for the 2022 growing season

Characteristics		Unit	Value
pH		-	7.15
Electrical conductivity (EC)		ds m^{-1}	5.86
dissolved positive ions	Ca+2	mmole	31.14
	Mg+2	mmole	26.88
	Na^{+}	mmole	2.12
	K+	mmole	1.14
Organic content		%	1.63
Dissolved negative ions	HCO^{3-}	mmole	23.22
	$CO3^{-2}$	mmole	-
	$SO4^{-2}$	mmole	26.32
	Cl^{-}	mmole	9.66
Total nitrogen (N)		g.kg^{-1}	
Phosphorous (P)			
Cation-exchange capacity (CEC)			
Soil separates	Silt	%	42.70
	Sand	%	12.20
	Clay	%	45.10
Soil texture		-	Silty clay

El-Tohamy and El-Greadly (2007) investigated the effect of yeast spraying at 0, 5, and 10 gm/l on bean plants. According to the findings, the concentration of 10 gm/l increased the number of leaves, plant height, soft weight of foliar application, total yield, and seed content. The seed's content of protein, carbohydrates, and fiber was increased. The leaf content of N, P, and k reached the highest level, and the leaf content of hormones such as cytokinin, gibberellin, and indole acetic acid was increased.

MATERIALS AND METHODS

This research examined the impact of organic and biological fertilizers on the development of okra plants. It was carried out in a private field in the Al-Madinah neighborhood to the north of Basra during the 2022 growing season. The seeds were soaked for five hours prior to planting, and cow manure was added at 5% and 10% of the soil weight at a depth of 30 cm within the experimental unit designated for each level, according to the randomized complete block design (RCBD) (Al-Mohammadi, 2009). Yeast suspension was sprayed three times throughout the growing season.

The first spraying occurred a month after the seedlings were planted, and it was followed by two further sprayings separated by two weeks. The servicing and control activities were carried out following production standards.

Soil and fertilizer analysis was carried out before planting. Some chemical and physical properties were taken in the Soil and Water Department laboratory in the College of Agriculture, University of Basra.

Tables 1 and 2 show the results of these analyses. The outcomes were statistically evaluated using the RCBD (Randomized Complete Block Design) (Al-Rawi, 1980). At the end of the experiment, the following measurements were made:

Vegetative growth features the number of leaves, leaf area (m2), and plant height (cm). Crop characteristics: fruit quantity and the total plant yield.

Table 2. Chemical characteristics of cow manure after the decomposition period prepare the yeast suspension

Properties	Unit	Value
pH	-	7.10
Electrical conductivity (EC)	dSs m^{-1}	9.50
Organic carbons	g/kg	236.60
Total P	g/kg	11.14
Total N	g/kg	11.00
Total K	g/kg	4.20
Organic materials	%	149.05

According to the yeast concentration used in the experiment, the dry yeast suspension was dissolved in water and added sugar in a 1:1 ratio. It was left for twenty-four hours, then filtered with a wet cloth and sprayed on the plants (El-Tohamy and El-Greadly, 2007).

RESULTS AND DISCUSSION

Vegetative growth: Table 3 shows that the vegetative growth parameters significantly improved after adding organic fertilizer at a concentration of 10% and the spraying of biofertilizer at a concentration of 8 g/l, compared to the control. The highest averages for the number of leaves, leaf area, and plant height were 85.34 leaves, 1.48 m2, and 156.18 cm, respectively. Adding organic fertilizer may improve the features of vegetative growth since it improves the organic matter in the soil, the activity and quantity of microorganisms, and the continual addition of nutrients to the soil. This makes the soil more porous and lets more water and air through. It also restores the balance of nutrients (Hao *et al.*, 2008).

Organic additions improve the activity of the roots in the absorption of water and nutrients by warming the growth medium of the root system via the thermal accumulation caused by the decomposition of organic materials (Al-Ajeel, 1998). Additionally, organic fertilizers include vitamins, amino acids, and plant growth regulators that influence cell division and elongation, boosting plant height and leafy area and enhancing vegetative plant growth (Melo and Oliveira, 1999).

Bio-fertilizer spraying promotes more plant growth since yeast has a high concentration of protein, vitamins, and natural hormones (Ahmed, 2004). Yeast also contains cytokinin, which promotes cell division and elongation while increasing plants' nucleic acid, chlorophyll representation, and protein (Fathy and Farid, 1996).

Table 3. Influence of biological and organic fertilizer additions on vegetative growth.

Mixes	Plant height, cm	Leaf number	Leaf area, m²
Control	93.45	48.18	0.35
Organic fertilizer 5% + biofertilizer 2 g/l	135.42	65.76	0.38
Organic fertilizer 5% + biofertilizer 4 g/l	139.02	71.43	0.49
Organic fertilizer 5% + biofertilizer 8 g/l	141.76	78.32	0.53
Organic fertilizer 10% + biofertilizer 2 g/l	143.38	72.22	0.67
Organic fertilizer 10% + biofertilizer 4 g/l	152.32	78.62	1.08
Organic fertilizer 10% + biofertilizer 8 g/l	156.18	85.34	1.48
0.05 LSD	6.25	4.12	0.16

Crop characteristics**:** Table 4 shows that applying 10% organic fertilizer and spraying biofertilizer at an 8 g/L concentration increased yield characteristics compared to the control treatment. The average fruit weight and total plant yield were the greatest, at 4.86 g and 338.16 g/plant, respectively. The increase in yield in plants fertilized with organic fertilizer could be due to the potent vegetative growth represented by increased leaf area (Table 3). It increased the dry weight of the foliage application due to the increase in plant metabolism and its positive effect on yield (Neeraja and Reddy, 2005).

The decomposing organic fertilizer contributes to nutrient plants by enhancing the physical and chemical soil characteristics and raising the activity and quantity of microorganisms, which work to mineralize the elements and prepare them for the plant (Tejada *et al.*, 2006). Carbonic acid is formed when CO2 from microorganisms is dissolved in water (H2CO3). This reduces the soil's pH, making most components more accessible to the plant (Tisdale *et al.*, 1985).

Table 4. Influence of adding biological organic and fertilizers on crop characteristics.

Mixes	Fruit weight, g	Crop, g/plant
Control	2.72	128.26
Organic fertilizer 5% + biofertilizer 2 g/l	3.05	192.60
Organic fertilizer 5% + biofertilizer 4 g/l	3.34	227.68
Organic fertilizer 5% + biofertilizer 8 g/l	3.38	230.26
Organic fertilizer 10% + biofertilizer 2 g/l	3.67	261.41
Organic fertilizer 10% + biofertilizer 4 g/l	4.12	321.08
Organic fertilizer 10% + biofertilizer 8 g/l	4.86	338.16
0.05 LSD	0.75	5.66

Organic fertilizers hold the nutrients through adsorption on the surfaces of humus colloids, in which organic acids act as chelating compounds for the elements and prevent them from settling (Lorito *et al.*, 1993). The availability of plant nutrients was reflected in the improvement of vegetative growth and yield. The increase in yield in plants treated with biofertilizer may be due to the effect of the yeast content of amino acids, proteins, hormones, and vitamins, as well as some nutrients, on plant growth (Gomaa *et al.*, 2005). These results are consistent with what was found in cowpea by El-Tohamy and El-Greadly (2007) and Fathy and Farid (1996).

Conclusion**:** The experiment outcomes demonstrate that all indicators of vegetative growth and production were maximized by treating organic fertilizer at 10% concentration and spraying biofertilizer at 8 g/liter concentration. It attained the most significant values for plant height, leaf number, leaf area, fruit weight, and overall plant yield, measuring 156.18 cm, 85.34 leaves, 1.48 m2,4.86 g, and 338.16 g/plant, respectively.

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